DOCUMENT RESUME

ED 299 856 HE 021 732

AUTHOR Ellis, Susanne D.
TITLE Survey of Physics and Astronomy Bachelor's Degree Recipients, 1985-86. AIP Report.
INSTITUTION American Inst. of Physics, New York, NY. Education and Employment Statistics Div.
REPORT NO AIR-R-211.18
PUB DATE Apr 87
NOTE 10p.; For the 1986-87 report, see HE 021 731.
AVAILABLE FROM American Institute of Physics, 335 East 45th Street, New York, NY 10017-3483.
PUB TYPE Reports - Research/Technical (143) -- Statistical Data (110)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Armed Forces; *Astronomy; *Bachelors Degrees; *College Graduates; College Preparation; Economic Change; Employers; *Employment Patterns; Enrollment Trends; Entry Workers; Financial Support; Higher Education; *Labor Market; National Surveys; *Physics; Salaries; Student Characteristics

ABSTRACT

Results of the American Institute of Physics' 1985-86 annual survey of bachelor's degree recipients in physics and astronomy are reported. Data are presented in tables, with accompanying narrative analysis. The information on physics students includes: trends in postbaccalaureate plans of successive graduating classes of physicists from 1977-78 through 1985-86; characteristics of new physics degree recipients (sex, citizenship, age, minority group membership, transfer from a junior college, double major, type of undergraduate institution), presented by intended postbaccalaureate activity (physics or other graduate study, employment, or undecided); comparative high school physics preparation for men and women; postbaccalaureate plans by minority group; trends since 1975 in undergraduate physics students without high school physics preparation; foreign and American minority group student plans and characteristics (sex, age, region and type of bachelor's institution); sources of anticipated support for first-year graduate study; change in numbers of job offers at graduation for the summers of 1975 and 1980-86; initial employment; starting salaries, by sex; and work activity and type of employer for new graduates. Similar but less extensive information is included for astronomy graduates. (MSE)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED299856

AIP REPORT EDUCATION AND EMPLOYMENT
STATISTICS DIVISION

American Institute of Physics, 335 East 45th Street, New York, NY 10017
Telephone (212) 661-9404
Telex 960983/AMINSTPHYS-NYK

1985-86 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

by Susanne D. Ellis

AIP Pub. No. R-211.18 April 1987

HE021 732

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

AIP

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.
☑ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

AIP report
EDUCATION AND EMPLOYMENT STATISTICS DIVISION
American Institute of Physics, 335 East 45th Street, New York, NY 10017
Telephone (212) 661-9404
Telex 960983/AMINSTPHYS-NYK

1985–86 Survey of Physics and Astronomy Bachelor's Degree Recipients

by Susanne D. Ellis

AIP Pub. No. R-211.18 April 1987

After several years of significant annual increases in the number of physics bachelor's degrees granted, the size of the class of 1986 is almost the same as that of the previous year. The number of astronomy bachelors, on the other hand, indicates the first substantial increase in three years. The survey upon which this report is based collects information from individual degree recipients and focuses on their postbaccalaureate plans. Comparisons are made with data from earlier years and trends are shown where possible. Highlights of the information presented in this report are:

- The proportion of physics bachelors who had not taken physics in high school rose to 21% for the class of 1986.
- Starting salaries reported by the class of 1986 declined by 4.5% to $1900/month.
- Almost 90% of the employment-oriented physics bachelors felt that their initial employment utilized their training.

In view of the anticipated demand for physicists, attention is being focused each year on the career goals of the new physics bachelors to determine how many of the graduates can be classified as "potential physicists". Using the widely accepted definition that a physicist is a person with at least a master's degree in physics and preferably a physics doctorate, we presume that those who reported acceptance into a graduate physics program are the most likely candidates for a career in physics. However, a small proportion of the new physics bachelors each year pursues a different and somewhat longer approach to a career in physics. Approximately 200 graduates interrupt their studies for a year or two in order to try full-time employment and subsequently immerse themselves in a physics doctoral program for five or six years. Thus, what appears to point to a slowly decreasing proportion of "potential physicists" in **Figure I**, may not present an entirely accurate comparison between physics graduate study and employment plans. The third major group reported "other graduate study" which by and large refers to disciplines closely related to physics. Both **Figure I** and **Table I** show the postbaccalaureate plans of physics bachelors for the past ten years and how gradual the changes

Figure I. Trend in postbaccalaureate plans of physics bachelors, 1977–1986.

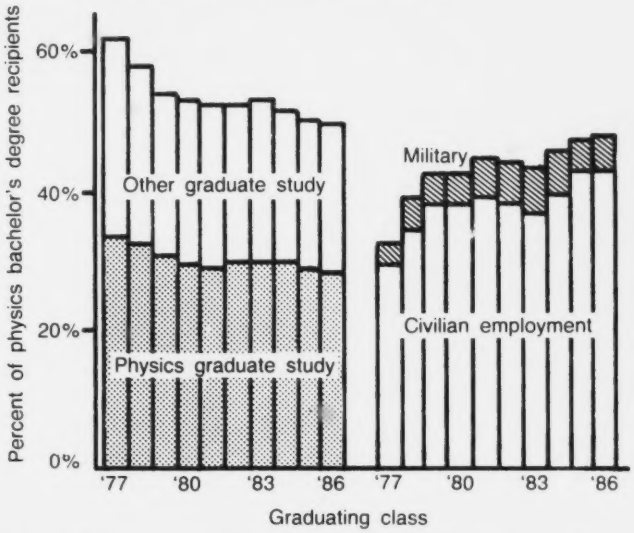


Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1976–1986.

Postbaccalaureate plans	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85	1985–86
Physics graduate study	34%	33%	31%	30%	29%	30%	30%	30%	29%	28%
Other graduate study	28	26	24	24	24	23	24	22	21	21
Civilian employment	30	34	38	38	39	38	36	40	43	43
Military service	4	5	5	5	6	7	8	6	5	6
Undecided	4	2	2	3	2	2	2	2	2	2
Total number of physics bachelor's degrees	4517	4457	4416	4440	4513	4558	4795	4878	5188	5214

MEMBER SOCIETIES:
AMERICAN PHYSICAL SOCIETY • OPTICAL SOCIETY OF AMERICA • ACOUSTICAL SOCIETY OF AMERICA • SOCIETY OF RHEOLOGY • AMERICAN ASSOCIATION OF PHYSICS TEACHERS • AMERICAN CRYSTALLOGRAPHIC ASSOCIATION • AMERICAN ASTRONOMICAL SOCIETY • AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE • AMERICAN VACUUM SOCIETY • AMERICAN GEOPHYSICAL UNION

Table II. Characteristics of new physics bachelors, 1985–86.

Characteristics		• Postbaccalaureate plans				
		Graduate study				
		Physics	Other	Employment	Undecided	Total
Sex	Female*	14%	16%	15%	18%	15.0%
	Male	86	84	85	82	85.0
Citizenship	U.S.	92%	92%	97%	92%	94.0%
	Foreign	8	8	3	8	6.0
Age	20 or younger	1%	1%	–	–	0.5%
	21	6	4	2%	3%	3.5
	22	44	48	32	41	38.6
	23	23	21	28	30	25.1
	24–27	19	20	27	20	22.9
	28 or older	7	6	11	6	9.4
Minority groups	U.S. blacks	1.3%	2.4%	1.9%	3.3%	1.8%**
	Other U.S. minor.	4.3	5.0	4.4	–	4.3
	Foreign minorities	5.2	6.0	2.3	3.3	3.9
Transferred from junior college	Yes	9%	7%	14%	9%	11.0%
	No	91	93	86	91	89.0
Double major	Yes	29%	40%	25%	34%	30.2%
	No	71	60	75	66	69.8
Type of undergraduate institution	Public	58%	45%	64%	49%	57.8%
	Private	42	55	36	51	42.2
	PhD-granting	59%	46%	46%	49%	49.9%
	MS-granting	12	11	11	–	11.3
	BS/BA-granting	29	43	43	51	38.8
Total number of bachelors		1455	1100	2544	115	5214
% distribution		28%	21%	49%	2%	100%
Number of respondents		776	587	1360	61	2784

**Percentage of women was adjusted for differential response rate.*
***Data from the Survey of Enrollments and Degrees indicate that blacks comprise approximately 4% of the total number of physics bachelors.*

were during that period. For example, a decade ago fewer than one-third of the new graduates chose civilian employment; by 1986 that proportion had risen to 43%. Corresponding decreases are divided between the two groups with graduate school plans and slanted toward those who changed to another subject of study. The bottom row of **Table I** lists the total number of bachelor's degrees granted each year; these data are derived from the departmental survey of Enrollments and Degrees.

A description of new physics bachelors in terms of their characteristics is more meaningful when the graduates are divided into groups according to their postbaccalaureate plans. **Table II** illustrates this statement by listing seven characteristics and showing their variations with respect to the four groups of physics bachelors. The greatest differences occur between the employment group and the other three. For example, employment-oriented bachelors are older, are more likely to have transferred from a junior college, include the smallest proportion of foreign students and have the highest proportion graduating from public institutions. However, certain characteristics in **Table II** are especially directed at the potential graduate students. For example, the last two characteristics show that graduate physics students are more likely to have chosen doctorate-granting institutions for their undergraduate training and the "other graduate study" group is most apt to graduate with a double major.

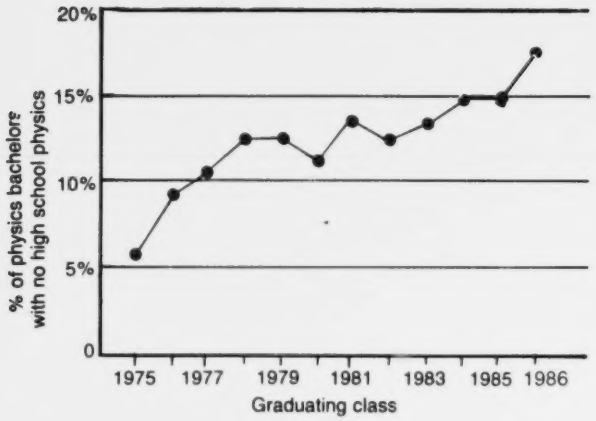
The teaching of high school physics is the responsibility of local governments; consequently there are school districts that either do not offer physics at all, or do not offer it every year. The implications of such a system are reflected in **Table III**. In addition to asking what type of high school physics course the graduate had taken, we were particularly interested in the proportion whose answers were "none". For all respondents combined, a four percentage-point increase was recorded in the most recent year. **Table III**

Table III. A comparison between men and women 1985–86 physics bachelors and their high school physics backgrounds.

Type of high school physics		Women	Men	Total %	Total N
PSSC*		16%	22%	21%	480
Project physics		10	13	13	282
Other		46	45	45	1027
None		28	20	21	467
Total respondents	%	100%	100%	100%	
	N**	339	1917		2256

**PSSC = Physical Science Study Committee*
***Nonrespondents to the question = 528*

Figure II. Physics bachelors, entering graduate physics departments, who did not take high school physics, 1975 to 1986.



also shows that a higher proportion of women appear to have avoided physics in high school.

Focusing on the "potential physicists," namely the subgroup of bachelors whose post-degree plan is graduate study in physics, we find that as many as 17% of them had not taken physics in high school. **Figure II** shows that since 1975 this percentage has increased rather rapidly; at that time it was 6% for the comparable subgroup of physics bachelors.

Having demonstrated in **Table II** how the characteristics of a composite group can differ significantly from those of its component parts, we apply a similar analysis in **Table IV** to the minority students among the physics bachelors. First we separate the foreign minorities because their legal status in the U.S. makes them ineligible for regular employment and thereby biases the distribution of their postbaccalaureate plans. All U.S. minority respondents in the class of 1986 numbered 171 and their combined postbaccalaureate plans were similar to those of all the respondents from that class. However, the plans of U.S. blacks continue to be more oriented toward "other graduate study" while the proportion of blacks enrolling in graduate physics programs remains 8 to 10 percentage-points below the class average. U.S. Orientals generally favor graduate study over employment at the bachelor's level while the plans of all other U.S. minorities appear to be close to average.

Additional details on minorities are provided in **Table V**, which lists six distinct minority groups and the numbers of physics bachelors who identified themselves with each group. The larger groups that are neither predominantly foreign nor predominantly U.S. are divided on the basis of citizenship and, compared to the previous year, we call attention to noteworthy increases in the numbers of U.S. blacks and foreign Orientals. The four characteristics presented in **Table V** indicate that U.S. blacks continue to include a relatively high proportion of women and that blacks are concentrated in the four-year colleges. Orientals, on the other hand, tend to choose PhD-granting institutions for their undergraduate studies. The age distribution in **Table V** shows that minority bachelors are older than the average graduates at that level.

Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1986.

Minorities	Postbaccalaureate plans: Graduate study: Physics	Graduate study: Other	Empl.	Total: %	Total: N
U.S. blacks	20%	27%	53%	100%	51
U.S. Orientals	27	27	46	100	60
Other U.S. minorities	28	22	50	100	60
Total U.S. minorities	25%	25%	50%	100%	171
Foreign Orientals	36%	32%	32%	100%	53
Other foreign minorities	38	33	29	100	55
Total foreign minorities	37%	32%	31%	100%	108
All respondents	28%	21%	51%	100%	2784

Table V. Selected characteristics of minority physics bachelors, 1986.

		Minority group: Black U.S.	Black Foreign	Amer. Indian	Hispanic U.S.	Hispanic Foreign	Oriental U.S.	Oriental Foreign	Asian Indian	Arab
	Total	51	13	9	36	10	60	53	18	22
Sex	Female	9	1	2	5	1	6	7	2	4
	Male	42	12	7	31	9	54	46	16	18
Age	21 or younger	2	–	–	2	1	5	4	2	3
	22	14	2	2	14	3	17	15	7	9
	23	11	2	3	7	–	15	9	3	3
	24	11	2	–	3	1	11	9	3	2
	25–27	5	4	1	6	2	9	9	2	3
	28 or older	8	3	3	4	3	3	7	1	2
Region of bach's inst.*	Northeast	11	3	1	7	1	16	13	6	8
	Southeast	22	4	1	8	2	3	2	3	2
	Central & Mountain	14	3	4	7	4	14	14	5	6
	Pacific	4	3	3	14	3	27	24	4	6
Type of bach's inst.	PhD-granting	16	4	3	21	5	49	27	8	14
	MS-granting	4	–	1	1	–	2	8	2	3
	BS/BA-granting	31	9	5	14	5	9	18	8	5

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1982–86.

Sources of support	Students planning: Physics graduate study 1982	1984	1986	Other graduate study 1982	1984	1986
Teaching assistantship	64%	68%	66%	26%	32%	29%
Research assistantship	15	13	11	20	15	16
Fellowship	12	11	11	15	12	13
Employment (part-time)	3	3	4	13	16	17
Family, savings, loan	4	4	3	23	22	18
Other	2	1	5	3	3	7
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	94%	93%	91%	88%	83%	81%
Graduate study status: part-time	6	7	9	12	17	19
Total number of full-time students	1355	1475	1455	1066	1068	1100

The information was reported for September of each academic year.

The two groups of physics bachelors who plan to enter graduate programs frequently base that decision on the type of support they are offered. Teaching assistantships constitute the most common type of support for those who become graduate physics students. Physics bachelors entering other disciplines find fewer teaching assistantships available. **Table VI** lists the five major sources of anticipated support for first-year graduate students and compares their availability since the early 1980's. Research assistantships and fellowships supported a smaller proportion of the graduate physics students than those enrolled in other disciplines. However, where the need to use personal funds is concerned, or having to resort to part-time off-campus employment, we are comparing 7% of the graduate physics students with approximately 25% of the nonphysics group.

The lower portion of **Table VI** is based on a slightly larger group of new physics bachelors because it includes those who have accepted full-time employment and pursue graduate study on a part-time basis. Again we call attention to the difference between the two groups of graduate students. In physics the part-time students comprise less than 10% whereas those who entered "other graduate study" included almost 20% by 1986.

Either postponing or ignoring the graduate study necessary to become a physicist, appears to be a trend that has increased in popularity over the decades. For example, civilian employment as a postbaccalaureate plan was chosen by one-quarter of the physics bachelors in the 1960's, by one-third of them in the 1970's and by almost half of them in the 1980's. Consequently, analyzing the demand for physics graduates at that level, is an important part of this survey. To accomplish that we ask each employment-oriented bachelor for the number of job offers he or she received, which provides us with a scale of no offers, one offer and multiple offers. **Table VII** presents these data consecutively since 1980 in addition to 1975 for comparison purposes. It should be pointed out that "zero job offers" refers to the time immediately following graduation and should not be mistaken for a general unemployment rate. Thus an overall evaluation of the demand for physics bachelors is that close to 90% of the employment-oriented graduates accept positions shortly after graduation, although the proportion of graduates that reported multiple offers has definitely declined since the late 1970's.

Despite the frequent use of the term "plans" in this report, a large proportion of the graduates have made firm commitments to different postbaccalaureate activities. **Figure III** offers unique details of the plans that have already materialized as well as those that are still pending by the end of the summer of 1986. The flow diagram lists the major subjects of graduate study for those physics bachelors who chose a physics-related or another discipline for their graduate work.

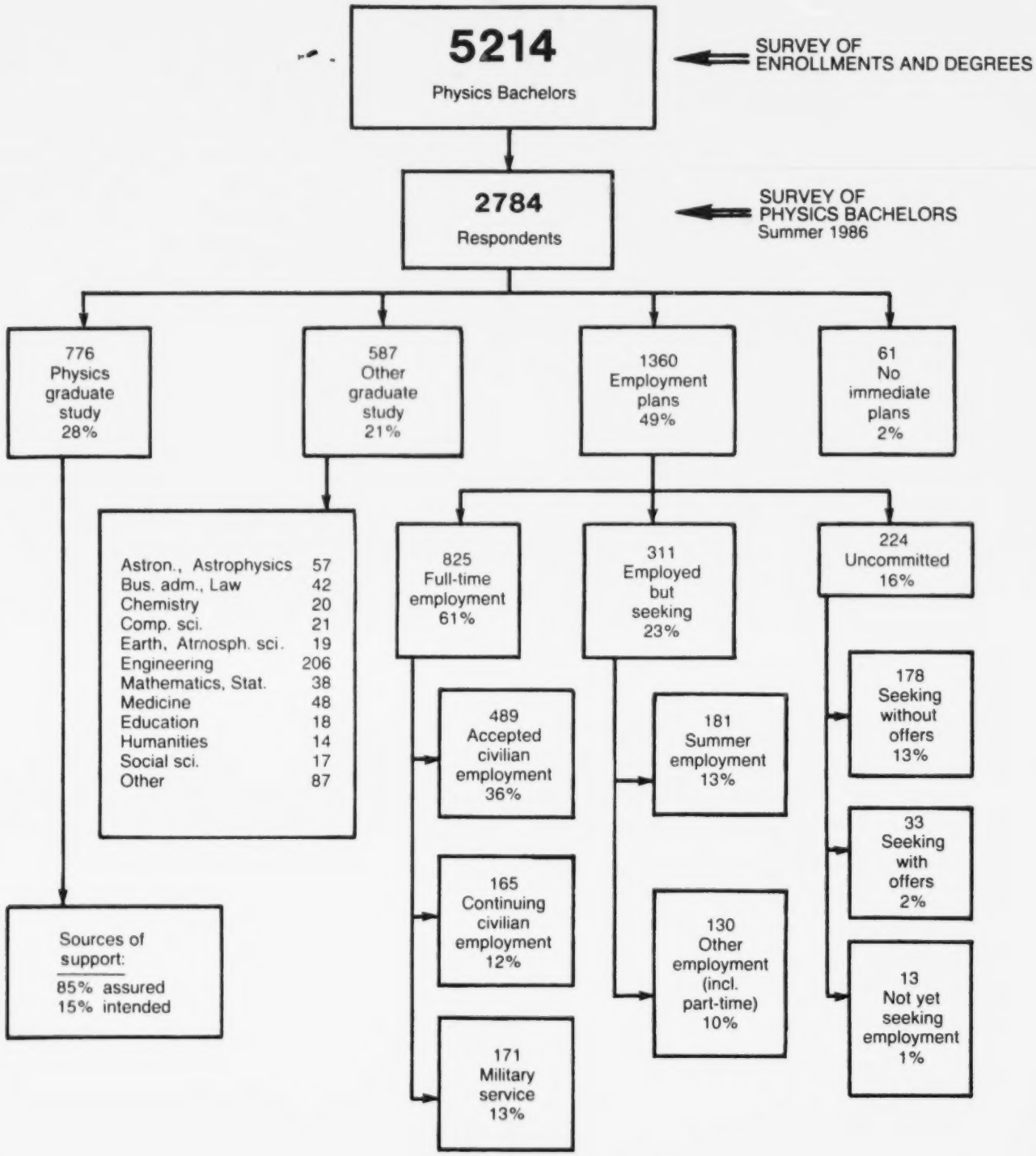
Since the proportion of employment-oriented graduates continues to increase, we expanded the number of categories for this group from two to three in **Figure III**. The new category constitutes 11% of the respondents to the survey and is labeled "Employed but seeking." A majority of that group,

Table VII. Changes in employment outlook for new physics bachelors, 1975–1986.

Number of job offers at graduation	Summer 1975	Summer 1980	Summer 1981	Summer 1982	Summer 1983	Summer 1984	Summer 1985	Summer 1986
0	17%	10%	10%	13%	11%	13%	14%	13%
1*	56	50	55	57	58	54	59	66
2 or more	27	40	35	30	31	33	27	21

Bachelors who enter the military service are included here.

Figure III. Postbaccalaureate plans of physics bachelors of the class of 1986.



and one substantially larger than in the previous year, reported "summer employment" but by and large it involved work that would be suitable on a potentially permanent basis. Other changes from the previous year include a substantial reduction in the proportion of bachelors who reported initial civilian employment (from 44% to 36%) and an increase in those who entered the military service. Our interpretation of these changes in employment choices will be discussed in connection with **Tables VIII** and **IX**. The proportion of uncommitted physics bachelors decreased by two percentage points, only one of which can be attributed to the group identified as "seeking without offers."

Table VIII. Initial employment of physics bachelors, 1976–86.

Type of employer	Percentage of employed bachelors									
	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85	1985–86
Industry {manufacture	32%	37%	40%	41%	40%	38%	33%	38%	35%	30%
Industry {service	16	21	18	20	22	22	20	16	20	18
High school	8	7	6	3	2	3	4	4	4	7
College or university	5	3	4	3	4	4	4	5	3	4
Government {civilian	7	7	7	8	7	7	10	12	14	13
Government {military	12	14	15	16	21	24	27	24	23	28
Other	20	11	10	9	4	2	2	1	1	–
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table VIII compares the distributions of initial employers reported by successive classes of physics bachelors over a ten-year period. The major change indicated by the class of 1986 was the decline in initial industrial employment and a corresponding shift towards the military and secondary schools. In 1986, the U.S. economy as a whole began to lose manufacturing jobs as our economy gradually shifts toward service industries. However, it should be noted that the types of positions accepted by physics bachelors in a service industry are largely technical or mathematically oriented and unlike those that economists classify as "service industry."

A direct result of this shift in types of employers was the overall lower median starting salary for all employers combined. The shift from industry to the military was far greater for men than for women, hence the combined salary for men declined by 5% while that for women rose by 8% from the previous year. Individual medians by type of employer are presented in **Table IX** which shows that many employers recorded modest increases of up to 6%.

By including in **Table X** physics bachelors who had decided to remain with employers for whom they worked before receiving their bachelor's degrees, we are increasing the percentages of bachelors employed in industry and by the government. **Table X** relates the different types of employers both to work activities and the use of physics training. With a larger number of respondents in 1986, we expanded the list of work activities to include management training. Research, development and design are the most frequently reported work activities, because industry continues to employ a majority of the new bachelors.

Table IX. Starting salaries of physics bachelors, 1986.

Type of employer	Men (458 reported salaries)		Women (62 reported salaries)		Total (520 reported salaries)	
	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary
Industry {manufacture	29%	$2280	33%	$2350	30%	$2300
Industry {service	18	2100	15	2330	18	2150
High school	6	1330	13	1470	7	1350
College or university	5	1530	1	**	4	1530
Government {civilian	9	1860	26	1790	11	1840
Government {military	31	1580	7	**	28	1590
Fed. Fund. Res. Ctr.	1	2250	3	**	1	2100
Other	1	1550	2	1500	1	1540
Total	100%	$1860	100%	$2160	100%	$1900

***Insufficient data.*

Table X. Full-time employment* of new physics bachelors, 1986.

Work activity	Type of employer: Industry manufacture	Industry service	High school	Government civilian	Government military	Coll. univ.	Other	Total N	Total %
Teaching	–	1	44	12	2	7	–	66	9%
Res. & dev.	63	24	–	41	20	19	3	170	23
Dev. & design	102	17	1	16	6	4	1	147	20
Programming	25	35	–	18	6	7	2	93	13
Skilled work	12	19	1	2	2	–	2	38	5
Specialized training**	1	1	–	–	96	–	–	98	13
Management training	6	10	–	1	6	–	1	24	3
Other prof. work	12	18	–	5	9	1	1	46	6
Other	13	15	2	7	17	2	3	59	8
Total N	234	140	48	102	164	40	13	741	
Total %	32	19	6	14	22	5	2		100%
Using physics training: Yes	90%	71%	94%	93%	93%	95%	100%		88%
Using physics training: No	10	29	6	7	7	5	–		12

The employment of these 741 graduates includes both newly accepted positions as well as those in which graduates are continuing. Excluded are graduates in temporary and summer employment.

**Training paid for by the employer includes pilot navigator training by the military.*

ASTRONOMY

There are sixty colleges and universities in the U.S. that grant astronomy bachelor's degrees, and in 1985–86 these institutions conferred 169 degrees. This total represents a significant increase over the previous year when only 145 astronomy bachelor's degrees were granted. These data were derived from a survey of astronomy departments and combined with reports from individual graduates who described their postbaccalaureate plans. Some of the findings from both surveys are included in **Tables XI** and **XII**. **Table XI** divides the astronomy bachelors into subgroups according to

Table XI. Characteristics of astronomy bachelors, 1986.

Characteristics		Postbaccalaureate plans: Graduate study Astronomy N	Graduate study Other N	Employment N	Undecided N	Total %
Sex	Female	1	1	–	2	5%
	Male	30	11	29	3	95
Citizenship	U.S.	29	12	29	5	97%
	Foreign	2	–	–	–	3
Type of high school physics**	PSSC *	4	1	7	–	20%
	Project physics	6	2	2	–	16
	Other	15	7	10	1	54
	None	2	1	4	–	10
Age	21 or younger	2	–	2	–	5%
	22	18	5	6	3	42
	23	8	2	10	2	29
	24	2	2	3	–	9
	25 or older	1	3	8	–	15
Type of bachelor's institution	PhD-granting	21	10	25	3	77%
	MS-granting	1	1	2	–	5
	BS/BA-granting	9	1	2	2	18
Type of degree	Science	20	6	26	3	72%
	Arts	11	6	3	2	28
Double major	Yes	12	6	9	1	36%
	No	19	6	20	4	64
Total respondents		31	12	29	5	77
Total number of astronomy bachelors		68	26	64	11	169

PSSC = Physical Science Study Committee.

**There were 15 nonrespondents to this question.*

Table XII. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1977–86.

Postbaccalaureate plans	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85	1985–86
Astronomy graduate study	33%	28%	35%	24%	29%	38%	38%	35%	40%
Other graduate study	22	19	17	13	25	17	31	18	16
Employment	40	51	43	59	45	41	28	44	38
Undecided	5	2	5	4	1	4	3	3	6
Total number of astronomy bachelors	177	165	165	156	181	138	137	145	169

their post-degree plans and highlights seven characteristics. **Table XII** compares the 1986 bachelors with those of earlier graduating classes and shows that each year a majority of the bachelors were interested in immediate graduate study.

Figure IV offers additional details on the 77 astronomy bachelors and their postbaccalaureate plans. For example, the distribution of sources of support for beginning graduate astronomy students differs from that of the physics students; a greater proportion secure fellowships. A comparison between the two employment-oriented groups shows a surprising similarity between physics and astronomy bachelors despite their large difference in number.

Figure IV. Postbaccalaureate plans of astronomy bachelors of the class of 1986.